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ABSTRACT

This paper presents and evaluates different types of student assessment measures--including discussion-generating questions, multiple choice questions, essay questions, and authentic projects--for on-line courses. The paper asserts that assessment should mimic how students will be evaluated on the job site in the real world, meaning that they should be team members and problem solvers, with the technological and academic skills to communicate the results of their actions. The findings are based on the researcher's experience as the teacher of an Internet-delivered course, "Earth Systems Science Approach to Physical Geography." The paper introduces the concept of "authentic assessment," a process that requires that the evaluation be realistic and force the students to use knowledge to solve real-world problems, which are often open-ended, poorly framed, and have no clear-cut answers. A scoring rubric, which provides the criteria for students to follow in order to receive a specified grade, is presented. Finally, the paper lists examples of the four assessment types, along with the goals, advantages, and disadvantages of each. It is concluded that on-line assessment of small Internet-based classes can be accomplished using many of the same assessment tools used in face-to-face classes. (CAK)

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On-Line Evaluation: Multiple Choice, Discussion Questions, Essay, and Authentic Projects

Gerald E. Nelson

Presented at the Third Annual Teaching in the Community Colleges Conference, online, April 7-9, 1998

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ON-LINE EVALUATION: MULTIPLE CHOICE, DISCUSSION QUESTIONS, ESSAY, AND AUTHENTIC PROJECTS

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ABSTRACT

Student assessment is a huge issue in Internet delivery of classes. College instructors are worried about how to assess student learning in traditional classes, and the problem appears bigger in on-line classes. If we understand what is going to be required of our students after they leave us, it is easier to determine how we should evaluate them, no matter what the delivery method. Students today are expected to be team-working problem solvers, with the skills (technological and academic) to communicate the results of problems solved. Assessment should mimic how students will be evaluated on the job site in the "real world." In other words, assessment should be authentic. In this paper I present several examples of on-line assessment tools I have used in my Internet-delivered "Earth Systems Science Approach to Physical Geography." Students can be engaged and evaluated with a combination of authentic discussion generating questions, open-ended essay questions, and authentic projects. Even multiple choice questions can be crafted to encourage student learning. Authentic evaluation is a much larger workload, compared to traditional objective evaluation tools.

INTRODUCTION

Evaluation of students in web based classes is a topic sure to generate discussion. When I talk about on-line teaching to interested colleagues, invariably one of the first questions is "how do you handle on-line assessment?" This question is quickly followed by "how do you keep them from cheating?" My answer to the first has been that I evaluate the same way I have in my traditional classes - I use multiple choice questions, short and long essay questions, discussion questions, and projects. The answer to the second question is that I cannot, so I don't worry about it, which is, at best, a very unsatisfactory answer for most.

What is it that society, mainly in the form of employers, wants from today's educated person? They want people who can work as members of a team to solve problems and who are able to communicate [1]. Today's educated person has access to reference material both off and on-line, modern computers with word processing, spreadsheet, and specialized software, and access to the experiences and backgrounds of co-workers. As educators, we often require that students perform in a way that is foreign to how they will

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eventually be performing. They will never be asked on the job to sit away from all reference material, forced to solve problems and communicate in isolation!

Casper College offers several traditional freshman and sophomore courses via the Internet. Our classes are modest in size, ranging from 5 to 25 students each and we offer 5 to 9 Internet courses per semester. The assessment examples in this paper are taken from my on-line "Earth Systems Science Approach to Physical Geography," a course I have taught for 21 years in the traditional classroom and for two years in the cyber classroom [2].

ASSESSMENT TOOLS

I believe that successful assessment in on-line classes lies in making the evaluation as realistic as possible. Students should demonstrate familiarity with a body of knowledge, be able to solve realistic problems, work efficiently and comfortably with each other, and communicate their results clearly. Essay exams, discussion questions, and projects require background knowledge, problem solving skills, and communications abilities. Doing these types of assessments on-line only adds to the realism of the assessment. I have evaluated student learning in my face-to-face classes using these tools; they are traditional evaluation tools, and I believe that I can successfully adapt them for on-line delivery. I feel it is possible to write materials that can fairly evaluate a student's grasp of the topic, their ability to problem solve, and their ability to communicate.

The key is writing assessment materials that provoke thought rather than require simple memorization. Writing multiple choice questions that do not require a single, simple fact item for an answer takes extra time. Open-ended essay questions are relatively simple to write, but take much more time to evaluate. Large, complicated, and realistic projects are difficult to craft and time consuming to evaluate. It becomes then not a problem of how do we evaluate on-line work, or how do we preventing cheating, but how do we design assessment tools for use in small-scale classes and programs that are realistic enough to make cheating next to impossible. We need to work with small enough groups of students to make this possible and effective.

It is too early in my own on-line experiences to be able to statistically judge the success of my approach. It may be that for small-scale programs such as those at many community colleges it will never be possible to statistically demonstrate the success of any particular approach to assessment. In my case, I can only base the degree of effectiveness on my years of teaching experience.

AUTHENTIC ASSESSMENT

My first encounter with the term "authentic assessment" was at a small conference on Internet teaching. One of the guest speakers used the term in passing, and it intrigued me. Each profession has many "jargon" terms, and I was curious if I could take this one at

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face value or if it had a deeper meaning, known only to the initiated. Like many teaching at the college level in a content-specific area, I have had minimal exposure to the academic field of education. I was gratified to learn that not only does "authentic assessment" mean what it says, I have been doing it most of my career.

According to the Educational Resources Information Center (ERIC) thesaurus[3],

> "..."Authentic assessment" is a particular context for alternative assessment in that authentic assessments explicitly simulate real-world problem-solving situations. Alternative assessment and authentic assessment both belong to the broader class called "Performance Based Assessment" because they both describe methods of student evaluation which are based upon the students' own constructed responses and other creations."

Wiggins [4] gives an additional definition:

> "Assessment is authentic when we directly examine student performance on worthy intellectual tasks. Traditional assessment, by contract, relies on indirect or proxy 'items'--efficient, simplistic substitutes from which we think valid inferences can be made about the student's performance at those valued challenges."

These definitions, and in particular the rest of Wiggins' paper, stress that the assessment is authentic if it is realistic and requires that students use knowledge. Real-world problems are sometimes open ended, poorly stated, and have no clear-cut answer. At times it takes a team approach to solve such problems, and the solutions may require specialized knowledge that is not immediately at hand in physical or human resources. If students are required to research, write, and communicate using the Internet, they are also practicing a skill that will become more important in the future.

SCORING RUBRICS

Students are often concerned with how grades are assigned, especially on written assessments. I evaluate each written assignment carefully using criteria (listed below) based on a paper by Tewksbury [5]. I caution students to study these criteria carefully, especially if they get lower grades than they think they should. On-line students in particular, in my experience, need to be reminded on occasion that simply putting in time and doing all of the work will not guarantee a high grade. I use pluses and minuses for work close to the borders of the next highest or next lowest grade. This scoring rubric is certainly not as cut and dried as an objective true-false, multiple-choice type of exam, but I find my scoring is remarkably internally consistent when I use it.

> CRITERIA FOR "A" RANGE GRADE: Outstanding explanation with superior supporting information; unusual insights and flashes of brilliance in the discussion; creative and original analyses and thoughts, goes well beyond the

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minimum required for the assignment. Writing has a real sense of style, with excellent organization, very few grammatical or spelling errors. DOES NOT read like a first draft.

CRITERIA FOR "B" RANGE GRADES: Good solid job on explanation, with excellent support from examples, data, or figures; excellent reasoning and explanations in the discussion, goes beyond the minimum required for the assignment. Writing has good organization, interesting sentences, few grammatical or spelling errors. DOES NOT read like a first draft.

CRITERIA FOR "C" RANGE GRADES: Good solid job, does what the assignment asks, decent reasoning and explanations in the discussion, decent support from examples, data and figures. Writing has decent organization, serviceable prose, READS LIKE A FIRST DRAFT. Papers with "A" or "B" level writing but numerous errors in spelling and grammar (indicating lack of proofreading) will only receive a "C."

CRITERIA FOR "D" RANGE GRADES: OK explanations and discussions but too general or some inaccuracies or flaws in reasoning or science; coverage is accurate but cursory and does not meet the minimum required for a complete answer. Writing is disorganized, awkward sentence structure; poor grammar and spelling; READS LIKE A FIRST DRAFT.

CRITERIA FOR AN "F" GRADE: Doesn't effectively address the question, fails to support assertions with data or examples, unclear explanations, inadequate understanding demonstrated; major flaws in reasoning or explanations. Writing is very disorganized, awkward sentence structure makes it difficult to read; poor grammar and spelling.

SOME EXAMPLES

DISCUSSION GENERATING QUESTIONS

In keeping with the authenticity of the evaluation, I encourage students to engage each other in debate via the class listserve. The requirement is a minimum of three posts per unit for 20% of the grade, but this minimum is far exceeded by the most active students. Students are asked to engage in lively debate, and follow common sense rules of good taste, manners, politeness, and netiquette. Communicating, working together, debating, learning to ask questions - in many ways, the Internet and listserve (or any type of chat capability) provides richer opportunities for discussion than a face to face class. Comments and responses to questions are more thoughtful, less "off the cuff" and likely more scientifically accurate. Students have less of an ability to "lurk," they are either actively participating or it is very apparent that they are not. This gives me the opportunity to intervene early enough to save a grade or advise the student drop the class.

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One of the first discussion generators I pose is deceptively simple, giving me plenty of on-line teachable moments. I ask them to:

> "examine an accurate map of North America. List the state (considering all 50) that is: (a) farthest north, (b) farthest south, (c) farthest east, and (d) farthest west."

Most students answer correctly that Alaska is farthest north and Hawaii is farthest south, but answers to the other two vary widely. Most do not guess right off that Alaska is simultaneously farthest east and west, as well as north. This leads into good discussions on the international dateline, both as observed and official, the meanings of "east" and "west," and the derivation of the geographic (latitude and longitude) grid system.

Later discussion generators are not so simple. The following question, for example, ties several topics together, using a regionally important example:

> "Find as much information as you can about Yellowstone Park volcanic area, beginning with this web site: (http://vulcan.wr.usgs.gov/Volcanoes/Yellowstone/framework.html). This volcanic area is far from any present-day plate boundary, yet volcanic activity here is related to plate tectonics. Discuss the origin of this volcanic area, what the magma source is, and what the potential hazards are to people and the local environment. Think about this point: Yellowstone Park is a "repository" of sorts for wildlife - numerous species thrive here in great numbers, including some that are on the endangered list. How wise is it of us as a society to place these animals here in an ostensibly "protected" place, when at any moment, the volcano could come to life and wipe them all out?"

This discussion encompasses aspects of the biosphere (biology, zoology), lithosphere (geology, volcanology), and human interactions with these environmental realms. It is open ended ("find as much information as you can...") which leads students in different directions and to various depths into the topic. When they come together in the listserve discussion phase, a rich information-sharing and lively discussion ensues. Students taking a science course for a general studies requirement will undoubtedly face a time where, in their professional lives or as a voting citizen, they must make a decision regarding issues of human interaction with the natural environment.

MULTIPLE CHOICE QUESTIONS

Even though I use multiple choice items for some of my assessment (30% of the possible points) and multiple choice is not necessarily authentic, I do so for these reasons. First, I use them to emphasize some terms and concepts that think are important and that I want students to pay extra attention to. If they re-read the appropriate section of the on-line or paper text material while answering the question, so much the better; for some, sad to

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say, it may be the only time they read the text. The idea is to let them know what is important, and this is a familiar way to do so.

Some of my questions are rather ordinary, if they don't do well at these, they will not do well in the class, and if they find out early enough students can get into another class or drop this one. For example, the question:

> "The angular inclination of the Earth's axis with respect to the plane of the ecliptic A) varies through the year B) is 0 degrees C) is 23.5 degrees D) is 66.5 degrees E) is 90 degrees."

This question illustrates a basic point, and seeking the correct answer leads to several other basic points. The Earth's axis does not vary much from 23.5 degrees tilt away from the perpendicular to the plane of the ecliptic. This enters into concepts of seasonality, climate, climate change, and so on. If a student cannot be bothered to look up and read this material, it is best that we both find out about it early. A follow-up question is a bit more difficult:

> "The fact that at any time during the year, the earth's axis is parallel to its orientation at all other times is called its parallelism, or: A) revolution B) rotation C) polarity D) aphelion E) perihelion."

This is nearly the same question; it deals with the same issue but a different aspect of it. The polarity of the Earth's axis means that it is always pointed to the same spot (the North Star) all of the time. This again emphasizes the concepts of seasonality, climate, and climate change.

Others of my multiple-choice questions are not ordinary. For example:

> "You are navigator on a ship in the South Seas. You have traveled for 6 days due south. You have noticed that the sun, at 12:00 noon, is now about 12 degrees lower in the sky. Estimate about how far south have you traveled. A. 200 km., B. 666 km., C. 1332 km., D. 828 km., E. cannot tell with information given."

More than half of my students answer E, "cannot tell with information given" because they do not stop and take the time (despite the quiz being on-line and accessible 24 hours of the day) to think about what is being said. Due south must be along a great circle, each degree traveled along a great circle covers about 111 kilometers, so the correct answer must be 1332 kilometers. The answer to this question cannot be looked up in a book, it can only be calculated by putting together several disparate factual items, and calculating the result.

Another is a favorite of mine because I hear rumors (unsubstantiated) that it is a question asked of graduating seniors at an ivy league school, most of whom could not answer it correctly:

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> "The best reason to explain why winter is usually colder than summer is: A. The sun is lower in the sky and the days are shorter, B. The snow reflects incoming solar radiation, C. There are more clouds in the winter to intercept solar radiation, D. The earth is farthest from the sun in the winter, E. The sun radiates less in the winter.

Surprisingly, most people answer "farthest from the sun" when in fact the answer is "the sun is lower in the sky and the days are shorter." This is a thinking question, and again the answer can only be found by putting together two or more bits of information.

ESSAY QUESTIONS

Open-ended essay questions are the easiest and quickest to write, and the most difficult to evaluate. Even though they are straightforward as far as the topics go, they are not easy for a student to do well at. This is a very authentic experience in that many things we do in our professional lives are rather mundane - mundane but important, and we need to be able to effectively communicate the ordinary results and insights in as clear a language as the most profound. Open-ended questions give the students the opportunity to demonstrate mastery over written communication and understanding of the science. One of my first questions is to:

> "Explain in your own words the differences between a large scale map and a small scale map."

I do not accept ordinary answers, written straight from the book. Students have a copy of the scoring rubric, I follow it faithfully, and I look for signs of "unusual insight" or "flashes of brilliance." Many of the open-ended essay questions are the typical compare, contrast, and discuss type of questions. For example:

> "Describe, discuss and compare the four mechanisms that can result in the uplift, cooling, and ultimately condensation of an air mass."

There is nothing surprising here, the four mechanisms can be looked up in any textbook. The student (very authentically) is not being evaluated on the memorization of four items, but on the ability to communicate his or her understanding of these four mechanisms in a clear manner.

AUTHENTIC PROJECTS

I consider laboratory projects to be the most important part of Internet science courses. Written (and illustrated) reports of project results count for 50% of the final grade. The Internet medium lends itself well to a laboratory setting, but you may have to shed some old ideas of what "LAB" really is! In traditional geography labs, students would be working with and answering questions about maps and other images. It is no different in an Internet class, except that the images come from the Internet.

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Laboratory projects allow the student to get closer to the real world and real world ("authentic") problem solving. It also is a good training ground to obtain an appreciation of scientific methods and develop communication skills. Good information, insightful ideas, well developed solutions to problems, and brilliant analyses are all useless unless students are able to communicate them to others. Students are required to work in teams for two out of the eight projects, and encouraged to work together on the rest. The requirement that they work together causes more complaints than anything else we do in Internet classes, even though most students recognize the necessity of learning to do group work. The biggest fear is, of course, that their hard work will go unrecognized, and that others will benefit from their efforts. Nothing could be more "authentic" in student training for the real world! It is relatively easy to determine in short order who participates and who does not, making such fears groundless. Students are held individually responsible for knowing the material, and they are responsible for their own reports.

There is some overlap between projects and discussion questions, and this is intentional. Projects differ in that students are required to be more thorough in their research, more complete in their reports, and they are given more time to complete the assignments. Projects require work with the textbook, the instructor, the Internet, and other outside sources. Each project is designed to explore a key concept, a body of knowledge, or a method of study and analysis.

The first project is straightforward and relatively simple, designed to introduce the students to the resources on the web, how to access those resources, and how to communicate the results their projects to the instructor and their classmates. I ask for a simple on-line search:

> "After you read the chapters and visit this site, do a search on the topic of "Earth Systems Science," "Physical Geography," and/or "Environmental Science." Send the results of your search to me, and I will collate the results and share them with the rest of the class. Please annotate your search results, that is, tell the rest of the class something about the sites, are they good and scientific, or off the wall? You will find all kinds on the net! Are they useful? Does they lead to other useful sites? Are they "user friendly?"

This project has a realistic goal; one that can be accomplished in short order, and one that gets students familiar with the mechanics of the Internet faster than most anything that an instructor can assign. It is important to facilitate early success in what might be a daunting medium for many students. I have seen students absolutely blossom and "take off" after this project, like opening the floodgates to all the knowledge of the world.

The second activity is not so much fun. Students are assigned to groups, a group leader is selected, and a group project assigned. I do not intervene in the group dynamics unless it is an emergency. I leave it up to the students to divide the labor, set their own deadlines (within my time frame) and decide the final format. I encourage electronic submittals, but I accept any format except handwritten. Some groups will "carry" a non-participant, and

others will complain loudly and at length about a similar non-participant. The group project is based on another search:

> "Your group project for this two-week period is to search the internet on the topics of 1) atmosphere composition, energy and temperature, and structure and 2) ozone in the atmosphere. The first is a general topic, and the second is a specific topic within the first topic. You will likely find lots of information on ozone, and perhaps not so much on the general composition, temperature and structure. However, do not ignore one topic at the expense of the other. The ozone problem cannot be fully understood without understanding its atmospheric context! Summarize and analyze your search results: Write a short report that demonstrates your understanding of atmospheric composition, energy, and structure. Specifically address the ozone layer and the apparent ozone problem. Your report should contain: 1) introduction, 2) summary of background information on the composition, structure, and energy content of the atmosphere, appropriately referenced, 3) a discussion of ozone and the ozone problem, and 4) a summary and wrap-up section. You should clearly distinguish your group's thoughts from your sources. It is strongly suggested that your report be appropriately illustrated. Please contact me with any problems well in advance of the deadline so that I can help you!"

This group project, which comes prior to the midterm, helps the students not only work as a productive team members, but it also helps them become familiar with downloading and submitting various digital formats for both pictures and text. It does not matter what the specific content area is in this case, it is very likely that these students will be involved with these tasks at some point in their education or their careers.

One of my favorite realistic projects deals with determining the return interval for floods of various sizes on most rivers in the United States. Not many students successfully finish this project; it is difficult, involving mathematics, spreadsheet analysis, graphing, and scientific interpretation. This is about as authentic as it comes - sometimes in the workplace we do not successfully finish a project, and they most often involve spreadsheets and computations.

Students download archived records of the peak flows for the Blackfoot River in Montana. The records run from 1940 to 1994, and some of the records are not necessary and not used, another authentic touch - how do we separate the data we need from the data we do not. Following instructions, students open the downloaded data into a spreadsheet, perform the mathematical analysis, and graph the final results. This generates a great deal of discussion, very high level for those with good mathematical background, and somewhat ordinary for those with poorer backgrounds. However, none of the analysis is obscure or difficult to follow, and nearly anyone can perform the analysis. Most of the questions involve "how to" manipulate data in a spreadsheet, open data files, download, and so on. After the analysis of the Blackfoot River is finished, students are asked to chose their own "favorite" river, and do a similar analysis. Most pick one close to their hometown, and some have been so enamored in the project they

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have interviewed local flood insurance salesmen and county planners. Again, this is the type of issue that can come up in profession or personal lives of students. This type of authentic assessment project gives them a background to understand complex issues.

CONCLUSIONS

On-line assessment of small web-based classes in small schools can be accomplished using many of the same assessment tools used in face-to-face classes. Student's evaluations should be weighted towards authentic assessments, assessments that require students to demonstrate skills sought after by today's workplace: communications skills, problem solving ability, and teamwork. Many of the assessment college instructors are already doing can be adapted to the Internet environment.

NOTES

[1] Secretary's Commission on Achieving Necessary Skills. What Work Requires of Schools. Washington, DC: SCANS, U.S. Department of Labor, 1991.

[2] A complete listing of my Internet classes, including Earth Systems Science approach to Physical Geography, can be found at this URL: http://wind.cc.whecn.edu/~gnelson/claslist.html. This site is not password protected, and also includes links to my online Montana State University Class in Earth Systems Science for K-14 educators, and my on-line University of Wyoming Class in Cultural Ecology. All examples in this paper come from this site.

[3] Definitions from the Thesaurus of ERIC Descriptors and the ERIC Identifier Authority List pertaining to concepts related to Authentic, Alternative, and Performance Based Assessment, ERIC Clearinghouse on Assessment and Evaluation (http://ericae.net), Shriver Laboratory, College Park, MD 20742.

[4] Wiggins, Grant, 1990, The Case for Authentic Assessment, ERIC Digest, No. ED328611

[5] Tewksbury, B.J., 1996, teaching without exams: The challenges and benefits, Journal of Geoscience Education, p. 366-372.

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